## Letters to the Editor.

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### Heredity and Acquired Characters.

(1) MOST biologists believe that the heritage travels down the germ-tract. (2) All biologists believe that in the germ-cell are none of the characters which the individual afterwards develops, but only potentialities for producing them in response to fitting nurture. (3) It follows necessarily that only potentialities are transmitted. (4) All that is transmitted is not produced (as characters of the individual), for fitting nurture may be lacking. (5) Therefore, inheritance and reproduction are not synonymous terms. (6) The individual can produce nothing but what was potential in the germ-cell, and nothing except in response to fitting nurture. (7) Necessarily, therefore, all characters are innate, acquired, germinal, somatic, and inheritable in exactly the same sense and degree. Given these facts and inferences, I asked biologists why they described some characters as "innate," "germinal," and "inheritable," and others as "acquired," "somatic," and "non-inheritable." I gave the example of the head and the scar, both ancient products of evolution. Why, when the child is like his parent both by nature and by nurture, is he said to inherit the head but not the scar? Why is the word "inherit" used as synonymous with "vary," its direct opposite, in the case of the scar? Really, I was asking for such definitions of biological terms as would accord with the current usage of them. As yet I have got none. I think I shall get none.

I may be wrong in thinking that biological terminology is vague, and sometimes even unmeaning, or I may be right. If I am wrong, surely some biologist can give the definitions I ask for. If I am right, the matter is of importance even as a mere question of words. A science cannot progress unless its workers have means of expressing themselves precisely and clearly. Other interpretative sciences—*e.g.* mathematics, physics, astronomy, and chemistry—have such means. It is noteworthy that they all possess in addition a body of established truth—truth which no one who knows the facts disputes. But biology can boast of scarcely an important interpretation (not even the theory of natural selection) which is accepted by everyone. As in religion and politics, its workers are divided into more or less hostile sects and sub-sects—Lamarckians, Darwinians, Neo-Darwinians, Mendelians, mutationists, Mendelo-mutationists, biometricians, and the like. I submit that much of this extreme, and apparently irreconcilable, divergency of opinion is due to confusion of thought consequent on confusion of language.

But beyond words, the matter is important. Biologists classify characters as "innate" and "acquired." Physiologists ignore this classification, and, assuming that all characters develop in response to nurture, endeavour to ascertain what forms of nurture evoke them. In other words, they classify characters according to the nurtures which cause them to develop—use, injury, this or that hormone, and the like. This classification is not merely different from the biological one; it is actually antagonistic; for, of course, if all characters equally arise in response to nurture, they must all equally take origin in germinal potentiality—must be equally innate and acquired. If biologists cannot justify their use of terms (supply valid definitions), it appears to me that they have no alternative but to accept the physiological classification. If that be done, I conceive that some such simple formula as "The sole antecedent of non-inheritance is variation. Apart from variations, like exactly begets like when parent and child develop under like conditions," will almost cover the field of discussion.

In reply to Dr. Ruggles Gates's letter in NATURE of December 2, p. 440, if we believe with Darwin in his theory of pangenesis that the parts of the child are derived from the similar parts of the parent (the child's head from the parent's head, etc.), the distinction between variations and modifications vanishes. Every modification is then a variation. We can distinguish only between germinal and somatic variations. If we believe that modifications in the germ's environment (the soma) may so impress the germ as to cause variations, then I think we are accepting what nobody questions, though I believe the importance of variations so caused has been greatly exaggerated. If we believe that changes in the soma tend to impress the germ-plasm in such a remarkable and unlikely way that the child reproduces in response to a different stimulus the character which the parent produced in response to the stimulus that Nature had fitted his race to respond to, then undoubtedly that child has varied from the parent. He is of a different nature; he has not inherited. I confess I do not see how Mendelians and mutationists *as such* are concerned in this discussion. They think that fluctuations are modifications, and that only mutations are true variations, and, therefore, that only the latter are inheritable—all of which is at least intelligible.

Prof. MacBride and Sir Ray Lankester (NATURE, December 16, pp. 500–1) may conveniently be answered together. But if, after reading what follows, Prof. MacBride will precisely indicate the "quibble" he writes of, I shall be much obliged. In reference to his last paragraph, if the child of a parent with an extra digit lacks that extra digit, or if he is relatively fair, then he has varied from the parent, has he not? Yet he has not departed from what is normal in the species. Prof. MacBride tortures a word which has now an established and perfectly clear meaning.

In 1911–12 I instanced a scar as a so-called "acquired character." Then, as now, Sir Ray Lankester quoted Lamarck in the original French. Lamarck wrote about the effects of use and disuse (not about the effects of injury). Therefore, *pace* Sir Ray Lankester, a scar is not an acquired character. Therefore, "if you, without any warrant, alter the established signification given by the Neo-Darwinian to the chief term in his statement, you can, of course, convert it into nonsense, and your proceeding is merely farcical." It is as if I had asked why kippers were called whales and Sir Ray Lankester had insisted that the term was restricted to red herrings. Fortunately, I am in good company. Did not Weismann himself cut off the tails of rats by way of demonstrating that acquired characters were not transmissible? If in my letter Sir Ray Lankester substitutes any use-acquirements he likes for "scar," his requirements will be met. In 1911–12 Sir Ray Lankester declared I was "doing harm." Influenced, doubtless, by the opinion of so great an authority, the Editor closed the correspondence. Thus was I crushed. The odd thing is that at the time I believed—as I do now—that I was fighting my critic's—or shall I say my contemner's—battles. We had travelled by different roads, but had reached, as far as I could judge, the same goal, and I was seeking to clear the ground. But more of this anon.

If the writings of Lamarck (notably the laws quoted by Sir Ray Lankester) and of those of his successors (*e.g.* Spencer, Romanes, Wallace, Weismann, and even Darwin) be examined, two assumptions will be found—never formally expressed, perhaps, but always apparent. On one hand, it is assumed that all characters develop in response to use. On the other, it is assumed that this development is never considerable. Both assumptions are monstrously wrong. Even in human beings many characters (*e.g.* hair, teeth, external ears, and external organs of generation) do not develop in the least in response to functional activity; on the other hand, in the higher animals, and especially in man, most characters develop from the infantile standard wholly, or almost wholly, in response to that stimulus. Physically and mentally man is the educable animal. He is immensely responsive to both use and disuse.

Low in the animal scale we find little or no evidence of development in response to functional activity. Apparently, even in an animal so high in the scale as a butterfly, use does not cause development nor disuse atrophy. In the egg use plays no part. We have no grounds for supposing that any structures grow during the caterpillar stage *because* they are used. In lack of functional activity the butterfly's structures develop vastly in the chrysalis. Afterwards functional activity does not cause them to grow. The evidence as regards mind is even clearer. In all its conscious phases this animal seems purely instinctive. It does not profit from experience, it does not learn, it is not educable. At any rate, if it develops at all in response to mental functional activity, it does so to a very small extent. Higher in the scale animals are born more and more helpless, but more and more capable of developing in response to use. Nature substitutes "acquired" for "innate" characters. That substitution marks the higher animal. Presently we find animals so capable of learning that mates are able to recognise one another, and also to recognise offspring. Thus family life arises, whereby offspring are afforded opportunity to develop in response to use. At last we reach man, who is born particularly helpless and immature, but enormously capable of growing through use, both in mind and in body. To this potentiality he owes all his adaptability, all his morality, religions, intelligence, knowledge, his whole intellectuality.

Now consider whether the problem of the "transmission of acquired characters" furnishes materials "for a legitimate inquiry." (1) The evolution of the power of developing in response to use is *the* feature of the rise of the higher animals. Steadily this potentiality increases at the expense of other potentialities. It may be argued, therefore, with some appearance of plausibility, that "innate characters" tend to be "transmitted" as "acquirements"; but the supposition that "acquirements" tend to become "innate" is, in the face of enormously massive evidence, ridiculous. (2) For thousands of generations the muscles of the boy have developed into those of the ordinary man in response to use, but no one has suggested that these "acquirements" tend to be "inherited"—to develop in the lack of use. But let one man (*e.g.* a blacksmith) display his human adaptability by developing his muscles by a little more use, and the Lamarckian immediately begins to wonder whether this last scrap of development is "transmissible." (3) Acquirements consequent on use and injury (made as Nature designed them to be made) are all useful. Transmitted, they would be less useful, or useless, or, more often, burdensome. For example, of what utility would scars be to an unwounded man, or the muscles of a blacksmith to his descendant the clerk? Lamarckians gravely argue, in effect, that after Nature has expended millions of generations in evolving a useful trait, this trait, directly it appears, tends to be converted into a useless trait. Here we have the oddest view of evolution conceivable.

To us as rational beings the evolution of the power of developing in response to use is immensely the most important phase of evolution. Of course, everyone is more or less aware of it. Thus parents know that it is necessary to train children, and even schoolboys know that men are more educable than dogs, dogs than cats, and so on. But it is remarkable how this tremendous truth has been ignored in scientific literature. If Lamarck and his supporters had realised it, would they have argued for the transmission of acquired characters? If Weismann and his followers had realised it, would they have condescended to argue against such transmission? Would any men have asked whether nature or nurture is the stronger? Would they have concluded that "nature is certainly five, and perhaps ten, times stronger than nurture"? What caused all this blindness to exceedingly obvious truth? Plainly, it was caused by the classification of characters as "innate" and "acquired." This led to the assumption that use-acquirements are of trivial magnitude, and so threw a veil over reality.

Men of science who study organic Nature—zoologists, botanists, palæontologists, anatomists, physiologists, bacteriologists, psychologists, and the like—are necessarily specialists and, unless they pass the boundaries of their particular studies, very narrow specialists. Biology supplies the connecting links. Every science is at first purely descriptive. Later, as the woof to the warp, interpretation is added. As Newton interpreted facts of astronomy, so Darwin accounted for the structures which zoologists, botanists, and palæontologists describe. Physiology is accounting for the facts of anatomy. It tells, among other things, of the influences in response to which structures develop. Pathology and bacteriology are accounting for the facts, that medical men have described, in terms of causation (nurture). But psychology is as yet, in very great measure, purely descriptive, and, even so, in a very limited field. Perception, conception, association, and the like have been described, but there are other and, for people who seek practical results, even more important characters—*e.g.* courage, cowardice, chivalry, meanness, energy, prejudice, and, above all, intelligence and stupidity. How do these traits, which in their sum constitute individual and national "character," develop? Do they arise in response to training (functional activity), or in response to influences (hormones and the like) largely beyond our present control?

Only biologists are able to settle these problems, for they alone are in a position to combine knowledge sufficiently deep and wide with relative freedom from blinding prejudice, religious and other. Presently, when, drawing on the vast stores of verifiable evidence which are available, they account indisputably for the various items of human character, science will come into its own. It will then have an indisputable title to control education and make it scientific in the sense that right means are adapted to achieve desired ends. It will raise issues far more burning and vital than even Darwin and Huxley raised. It will give a new reading to history. This is what I meant when I said I believed I was fighting Sir Ray Lankester's battle. But, obviously, the first step must be to achieve a right terminology, and so a valid classification of fundamental data. How, then, shall we classify characters—as "innate" and "acquired," or as responses to this or that form of nurture? This is what I meant by "clearing the field."

Of one thing I am very sure: that so long as the present classification is maintained biology will never be other than a tumbling-ground for whimsies—Lamarckian suppositions, questions as to whether nature or nurture is the stronger, and the like. When Darwin, the greatest figure that biology has produced, worked on lines of Lamarck's classification he went hopelessly wrong—as in his theory of pangenesis. His whole success was achieved when he studied, not differences between characters, but differences between individuals.

Prof. Poulton's letter in NATURE of December 23, p. 532, which I have seen since writing the above, is valuable for its line of thought and for its definitions. He begins by comparing *individuals,* and finds that their likenesses and differences are separable into those which are inherent (blastogenic) and those which are acquired (somatogenic). This is the firm ground which Darwin occupied in all his valid thinking. No one doubts the existence of these likenesses and differences, and most biologists believe that only those which are blastogenic tend to be inherited (perpetuated) by offspring. Thus chicks resemble each other innately in that they have heads and differ by acquirement as regards scars. Next, Prof. Poulton transfers the terms "inherent" and "acquired" from the likenesses and differences between individuals to the *characters* wherein they are alike or different. The head is called "inherent" and the scar "acquired." He is now comparing the characters of the same individual. This change, subtle yet vital, is precisely the cause of the chaos which prevails in biology. We are now in the morass in which Lamarck and Weismann floundered. We have departed altogether from Darwin's point of view. We have transferred the argument from the chestnut horse to the horse-chestnut. In what particular is the head more inherent and less acquired than the scar? Prof. Poulton writes: "Whenever change in the environment regularly produces appreciable change in an organism, such difference may be called an acquired character." Suppose I decide to work harder and so develop my muscles beyond the ordinary standard which they have already attained through use. In what respect is the addition more "acquired" than the ordinary development (which is usually termed "innate")? What would be the change in the environment?

I think I can give Prof. Poulton better definitions. Whenever the influence in response to which a character (*e.g.* a blacksmith's muscles, scars) develops is *glaringly* obvious, biologists call that character "acquired" and "somatogenic"; but whenever the influence is *not glaringly* obvious (*e.g.* ordinary muscles, head) that character is called "inherent" and "blastogenic." Whenever a biologist considers a character innate he reasons as if the soma and nurture had nothing to do with it. Whenever he considers it "acquired" he reasons as if the germ-plasm and nature had nothing to do with it. In all this he adheres strictly to ancient popular usage, and is not troubled by such recently discovered, recondite things as germ-plasms and germ-cells. He may talk about the latter unendingly, but they do not influence his thinking. Situated at the hub, whence radiate all sciences connected with life, biology, because of its unique classification of characters, has rendered not only itself, but also all these other studies relatively impotent—intellectually, socially, politically. It can use their data only to a minimal degree; and is not used by them at all.

G. ARCHDALL REID.

9 Victoria Road South, Southsea, Hants.

## The British Committee for Aiding Men of Letters and Science in Russia.

WE have recently been able to get some direct communication from men of science and men of letters in North Russia. Their condition is one of great privation and limitation. They share in the consequences of the almost complete economic exhaustion of Russia; like most people in that country, they are ill-clad, underfed, and short of such physical essentials as make life tolerable.

Nevertheless, a certain amount of scientific research and some literary work still go on. The Bolsheviks were at first regardless, and even in some cases hostile, to these intellectual workers, but the Bolshevik Government has apparently come to realise something of the importance of scientific and literary work to the community, and the remnant—for deaths among them have been very numerous—of these people, the flower of the mental life of Russia, has now been gathered together into special rationing organisations which ensure at least the bare necessaries of life for them.

These organisations have their headquarters in two buildings known as the House of Science and the House of Literature and Art. Under the former we note such great names as those of Pavlov the physiologist and Nobel prizeman, Karpinsky the geologist, Borodin the botanist, Belopolsky the astronomer, Tagantzev the criminologist, Oldenburg the Orientalist and permanent secretary of the Petersburg Academy of Science, Koni, Bechterev, Latishev, Morozov, and many others familiar to the scientific world.

Several of these scientific men have been interviewed and affairs discussed with them, particularly as to whether anything could be done to help them. There were many matters in which it would be possible to assist them, but upon one in particular they laid stress. Their thought and work are greatly impeded by the fact that they have seen practically no European books or publications since the Revolution. This is an inconvenience amounting to real intellectual distress. In the hope that this condition may be relieved by an appeal to British scientific workers, Prof. Oldenburg formed a small committee and made a comprehensive list of books and publications needed by the intellectual community in Russia if it is to keep alive and abreast of the rest of the world.

It is, of course, necessary to be assured that any aid of this kind provided for literary and scientific men in Russia would reach its destination. The Bolshevik Government in Moscow, the Russian trade delegations in Reval and London, and our own authorities have therefore been consulted, and it would appear that there will be no obstacles to the transmission of this needed material to the House of Science and the House of Literature and Art. It can be got through by special facilities even under present conditions. Many of the publications named in Prof. Oldenburg's list will have to be bought, the costs of transmission will be considerable, and accordingly the undersigned have formed themselves into a small committee for the collection and administration of a fund for the supply of scientific and literary publications, and possibly, if the amount subscribed permits of it, of other necessities, to these Russian *savants* and men of letters.

We hope to work in close association with the Royal